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"POCHA'S SEEDS SATISFY"

VEGETABLES FLOWERS BULBS PLANTS IMPLEMENTS

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STUDENT FARMERS' CLUBS GET STARTED IN MYSORE

B. RUDRAMURTHY, M.Sc., M.S.
Senior Assistant Director of Agriculture

The need to popularise improved agricultural practices among the rural people was perhaps never as keenly felt as at the present time. The country is getting alarming notices of not only the food shortage but also reduced fertility of the soil. All possible sources are being tapped to achieve self-sufficiency. It is the same situation that was largely responsible for the Food and Agriculture Minister's idea of 'land army' which was soon seen in action in many parts of India. This idea of harnessing the enthusiasm and service of our young men in the various urgent constructive activities, together with the splendid achievements of 4-H clubs and Young Farmer's clubs in Western countries immediately caught the attention of some active farm leaders in the State, and thus were started the Student Farmers' clubs in Mysore.

It was on June 24, 1951, that Hon. the Home Minister to the Government of Mysore commended the formation of these clubs while distributing the initiation badges to the members of the two newly formed clubs. His blessings and good wishes to the clubs were aptly preceded by a warning that such clubs should be more and more action-minded, and the members should take up to various aspects of improved agriculture and thus become an asset to the rural communities.

Four more clubs have been started since then, all in Bangalore Distirct. The fine response is primarily due to the young and enthusiastic members who are so keen on getting more and more information and experience in improved methods of agriculture. The interest they have been showing and the determination they have made are enough to make one more optimistic about what such clubs can achieve as time goes on. The extent of co-operation and enthusiasm shown by some of our leading raiyats indicates the full support our clubs are getting. In fact, it is with great appreciation one will have to mention the fine donation of a small bit of land to the club by Sri. Ardeshally Seetharamiah of Devanahally Taluk. Apart from his material help to the club, his kind acceptance to work as the leader of the club started there has really added life to the club activities. His rich experience in farming will undoubtedly be made use of by all our members. Incidentally this club was started with a very informal meeting, the members having

gathered underneath a tree. The main features of the meeting were informal discussions on objectives of the club, programmes and individual responsibilities of members, etc., and an exhibition of film slides showing the activities of 4-H clubs in America, and election of office-bearers for the club. It was later on followed up in another meeting, by a discussion of the programme of work to be undertaken. It is a good sign to see this programme is being kept up. Similar clubs have been started in Nelamangala and Hoskote Taluks and the support and help given by the leading raiyats here is highly commendable. Some farmers in Nelamangala Taluk with the experience of one club already functioning, are already keen on getting a few more clubs started ; and they are willing to offer lands for this purpose.

The part played by the local Agricultural Inspectors (counterparts of County Agents in U.S.A.) in forming these clubs and leading them cannot be ignored. In some places the credit for having made these clubs functioning should go in a large measure to these Agricultural Inspectors whose unfailing conviction and interest in the club activities are remarkable. But for their ability to move so smoothly with the boys and their parents on the one hand, and teachers and public on the other hand, we could not have progressed so fast.

What the Various Clubs are Doing

The student farmers' clubs are at present engaged in two main types of activities :

(*i*) Group Activities.

(*ii*) Individual Projects.

Group Activities

All the members of the club, with the leadership of the Agricultural Inspector or whomsoever they have selected as the leader, go out to farmers' fields in the neighbourhood during their spare time, study the agricultural problems of the area, and carry out such activities as composting, weeding, spraying against pests and diseases. At Nelamangala they have sprayed the potato crop against Epilechna beetle with three different chemicals to satisfy themselves regarding the most effective insecticide against this pest. Apart from their personal satisfaction their work was very much appreciated by the farmers. Even more satisfying is those young boys were awakened to the problem of pests and methods of control. This, undoubtedly, will attract their parents to the improved and scientific methods of agriculture. But are not these activities only a means to enable the boys to have a fuller realization of their role in life, and thus help to mould their future ?

The club members at Ardeshahally, in Devanahally Taluk, are tackling the problem jointly. They are farming a small piece of land

donated to their club. And in this work they are not only learning by actual doing the different agricultural operations in the cultivation of crops, but developing wonderful team spirit. The club idea is more strong in these boys, and with the good leadership available they undoubtedly will make progress.

These group activities induce in young boys a spirit of co-operation and co-ordination ; they will be proud of their club and its activities and achievements. The team spirit that comes out of it is wonderful.

Individual Project

Each member of the club selects a project of his own interest and works on that with the guidance of the club leader, and the Agricultural Inspector. For instance, one member in Hoskote Taluk has already started with a poultry project with two Rhode Island layers. A few members in Bangalore have very enthusiastically started gardening on small scale as their projects. Others are taking up vegetable cultivation. It is expected as the members become more and more oriented with the club work they will take up other projects such as calf-rearing, maintenance of cattle stall, construction of small articles or furniture, etc. It is very important to see that the members select the projects which suit with interests of the concerned members.

These project activities are a means for learning by actual doing. It induces a sort of healthy competition among members, the fruits of which will be duly rewarded in exhibitions and fairs. Each member will have to be stressed the importance of good work and keeping a good record of his work. He will naturally take pride in explaining his project work to others, and also to exhibit them in fairs and other places where a large number of visitors are attracted. The reward that a member gets for his work naturally results in personal satisfaction which keeps up his enthusiasm and interest in an unlimited manner.

Leaders in Student Farmers' Clubs

The leader plays a very important part in the success of these club activities. If he is a man of experience in farming and rural activities he will be more useful ; and with this experience, if he combines in him the art of winning the confidence of young boys he will be a very successful leader. A leader will have to constantly approach the members and their parents and enquire about their project work, give suggestions and help if need be and assist the members when required.

Because of the very position the leader holds in the success of our Student Farmers' clubs it is proposed to give preliminary training to all the club leaders. The programme in leader training would consist of not only the subject-matter in agriculture but such as how to conduct

a club efficiently. Arrangements will be made shortly to get all these leaders in a suitable place and to give them a good and effective training.

Conclusion

Although it is just the beginning, these Student Farmers' clubs have already given a promise of good future. In India, where a major section of the population is involved in agriculture, it would be a real service to the country if these clubs begin to function more and more, and awaken the interest of our farmers and rural people in better and more efficient methods of agriculture and happier ways of living. There is no doubt these clubs with modest beginnings will be more and more functional as time passes on.

Let us wish these clubs a successful future.

FICUS PALMATA AS A STOCK FOR FIG

Dr. L. S. Dorasami, M.Sc. (Lond.), Ph.D. (Lond.)
Economic Botanist

Propagation of fig is done both by seeds and by vegetative means. As it is easy to multiply the plant by layers, suckers and also by cuttings, seldom one thinks of propagation by seeds or of propagation by grafting. The usual practice at Bangalore is to raise the plants by either layering or cuttings. But at the Government Fruit Research Station, Hesarghatta, propagation of figs was tried successfully since 8 years by budding local figs using *Ficus palmata* as stock. Attempts are now being made to popularise this practice.

In the following pages it is discussed about the possibilities of *Ficus palmata* as a suitable stock for the propagation of fig, as this stock induces vigour and increases the yield of the scion, *viz.*, fig (*Ficus carica*) to a great extent. Further the effect of the scion variety of fig on the growth of the stock is illustrated by comparing the girth of the stock grown as such with that of the stocks top-worked with local fig scions.

The object of introducing fig among the miscellaneous fruit plants at the Station was to find out the comparative merits of the different varieties of indigenous figs and to study their cultural operations and also to study the cost of cultivation. With these objects in view rooted cutting of figs from Poona, Hyderabad, Bezwada, Ganjam and Bangalore were got and planted at the station during the year 1938. Except five plants of the Bezwada variety, the rest were all similar in their morphological characters and bearing habit. But of the seventy plants got from Bezwada five plants bearing the numbers 5, 28, 36, 41 and 60 were morphologically different from the rest in being very vigorous in their growth and having entire leaf-margin. The fruits of these plants did not ripen but dropped off a month after setting. It has not been possible so far to induce these fruits to mature. Herbarium specimens of these plants were sent to Sibpur for identification, where they were tentatively identified as *Ficus palmata.*

When it was not possible to make these plants bear fruits a novel idea to use them as stock for local fig occurred and it was started as follows :

Two plants out of the five were cut back to two feet and budded with the buds of the bearing Bezwada variety of fig in March 1939. The remaining three plants were top-worked. Two of them (Bezwada 36 and 41) were pruned, each branch having been cut back to

4" on September 3, 1940, near the first forking to induce young shoots for budding. Budding was done on the new shoots of ¾" diameter on Bezwada 36 on February 21, 1941, and on Bezwada 41 in November, 1941. In both these cases buds of Poona variety were used and 1 to 2 buds were inserted on each shoot. By the beginning of May, shoots 2 to 2½' in length were produced and they bore a number of fruits. In both the cases care is taken not to allow the stock plant (*Ficus palmata*) to put forth any shoots. The third plant, Bezwada 28, was top-worked with buds of all the five varieties in August, 1940, at different heights on its branches without pruning the plant as it is done in the case of the first two plants. Here a chance was given for both the scion and the stock to grow simultaneously. Even in this case the buds have sprouted as in the case of the other two plants. All the plants have grown vigorously. But in Bezwada 28, the branches of the stock plant are growing more vigorously than those of the fruiting variety. As the number of buds on Bezwada 28 inserted is limited, they have not affected the growth of the stock as adversely as the scions have done in the cases of other plants.

The above facts have been summarised in the following Table which gives the details about the girth, height, etc., of the budded plants using *Ficus palmata* as stock :

Plants numbers ..	5	6	36	41	28
Date of planting ..	19—9—38	19—9—38	19—9—38	19—9—38	19—9—38
Date of budding ..	17—7—39	17—7—39	21—2—41	15—11—41	15—8—40
Age of the stock at the time of budding in months	6	6	18	26	23
Present age of the plants in months	81	81	81	81	81
Age from the time of budding in months	63	63	53	43	58
Present girth in cm. ..	43·8	45·6	56·6	56·5	91·8
Present height in cm. ..	182	200	212	184	312
Number of fruits harvested for one season only	158	112	366	144	12
Maximum girth of the most vigorous Fig plant raised by cutting in the Bezwada variety in cm.	..	..	..	..	37·5
Average yield from the Bezwada plant	..	..	..	..	82 fruits

From this Table it can be stated that (1) *Ficus palmata* plants are more vigorous in growth than the ordinary fig plants, as it is seen from items 6 and 7 above. (2) Budding of fig on *Ficus palmata* is a success. (3) The maximum girth of the most vigorous Bezwada plant is less than that of the budded plants. (4) The girth of plants

budded when six months old (Plant Nos. 5 & 6) is less than that of the plant budded when it was 26 months old (Plant No. 41), indicating thereby that early budding lessens the vigour of the stock or indicating the adverse effect of the scion on the vigour of the stock, *viz., Ficus palmata.* Lastly, the yield of the other Bezwada plants is less than the yield of budded plants on *Ficus palmata* stock.

From the foregoing facts it can safely be said that *Ficus palmata* is a suitable stock for fig.

My thanks are due to Sri. N. S. Iyengar and Janab Ameer Ahamed Hyder whose indefatigable work and continued effort gave us these results.

SOME NEW AND MORE EFFICIENT FERTILIZER PRODUCTS

Dr. S. V. Govinda Rajan, B.Sc. (Hons.), Ph.D. (Lond.)
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During the period of World War II, in common with the developments and improvements that have taken place in the various industries, the fertilizer industry has also made considerable progress. In the decade prior to World War I, the notable innovation made in the fertilizer industry was the development by German chemists of fixing atmospheric nitrogen by economical methods and this, in the succeeding years, produced spectacular results in the vastly increased out-turn of nitrogenous fertilizers. In the period between the two wars, the most significant development in the fertilizer industry was the ammoniation of superphosphate, a development which allowed of the use by the farmer, of cheap forms of fixed atmospheric nitrogen. Though the developments in the recent War period have not been as spectacular as the earlier ones, the economic aspects of the improved methods have considerable importance in extending the use of various fertilizers. The improvements in the technological side during this period have mainly been directed towards producing more effective and concentrated forms of known fertilizers and at much reduced cost.

Advances in Phosphate Technology

The important developments that have taken place are in the production of phosphate fertilizers, and these may be considered first. During the century following the discovery in 1942 by Sir John Lawes, the Founder of the Rothamsted Experimental Station, of the process of making superphosphate, the phosphate industry, in common with the fertilizer industry in general, has grown tremendously. But the process of manufacture of phosphate fertilizers had shown but little progress. The traditional method has been to treat phosphate rock and other phosphate-rich materials with strong sulphuric acid, and getting a material containing from 14 to 26% of available phosphoric acid, the process usually involving a period of "Curing" and "Setting" of anything from 2 weeks to several months. Phosphate rock, the important raw material for this process, occurs in extensive deposits in the United States of America, Russia, North Africa and a few other countries. Though these reserves are plentiful and may last many years at the present rate of consumption, phosphates are an exhaustible source and in many places are getting depleted. Since an efficient use

of even the poor grade minerals becomes a necessary and useful step in effecting conservation of the present phosphate reserves, research and development have been proceeding to improve washing methods used in the recovery of even low grade phosphates which will thus facilitate more complete utilization of the raw materials.

In the recent production developments, emphasis has been placed on development of new plant nutrient processes which promise to reduce the cost to the farmer and provide more effective and concentrated fertilizers. One method of attack has been the development of highly concentrated products, since they make for economy by reducing the cost of bagging, handling, transport and storage costs. Simultaneously, processes for the production of low cost fertilizers of moderate concentration have also been developed, so that these economical production methods now permit of transportation of the materials even over great distances.

A summary of the major developments that have taken place, chiefly in the United States of America, would now be considered.

Triple Superphoshate

This is a fertilizer containing 45 to 50% phosphoric acid (available P_2O_5) and had been made till recent years by industry in relatively small quantities by the so-called "Wet process", using rock phosphate and sulphuric or phosphoric acids. Largely due to the programme of development and improvement of these processes by the Tennessee Valley Authority, an electric process of producing triple superphosphate containing 47% available P_2O_5 has been evolved and the product placed on the market. The process is claimed to produce the material at a very cheap cost.

Calcium Metaphosphate

This is a new product, the most concentrated phosphatic fertilizer yet produced and tested on large scale on the fields. It contains 63% P_2O_5, *i.e.*, more than 3 times the amount found in ordinary commercial superphosphate. This is a purely war-time development by the Tennessee Valley Authority involving a new and radically different process. In this method phosphate rock in the form of pulverized sand is blown directly into phosphorus-bearing furnace gases at about 1,200° C., to get the metaphosphate. Further, this method permits the use of relatively cheap phosphate sand, instead of the more costly and scarce, lump material. Calcium metaphosphate because of its high concentration, is of special interest in the problem of cheapening delivery costs. Since 1938 the American production has exceeded 65,000 tons, and in 1947, the T. V. A. authorities alone produced nearly 5,000 tons. The product, however, has not yet appeared on the Indian market.

Fused Tricalcium Phosphate

This fertilizer is produced by a cheap and relatively simple process, also developed by the T. V. A. and this product appears to have attracted considerable interest from commercial fertilizer producers. Phosphate rock contains considerable amounts of fluorine, which locks up the phosphate, making it unavailable as plant nutrient and useless to plants and animals. The T. V. A. process removes most of the fluorine by fusion of the rock in an oil-fired furnace. This gives a phosphate material of about 26-30% P_2O_5, being nearly 50% greater than ordinary superphosphate. Manufacture of this material requires neither sulphuric acid, nor high grade phosphate rock and the consumption of electric power is said to be not large. In addition no "curing" is necessary. Estimates of production costs appear to indicate that fused calcium phosphate could be produced more cheaply than ordinary superphosphate particularly if coal gas is used instead of oil. The fluorine content is also reduced to such a low extent that the material is considered fit for use as an animal feed supplement in place of the more commonly used bonemeal and boneflour.

During the year 1947, the T. V. A. production of fused tricalcium phosphate was more than 24,000 tons and most of it was used for fertilizers.

Diammonium Phosphate

This product contains nearly 75% plant food, being composed of about 54% P_2O_5 and 21% nitrogen.

The usual method for preparing this material has been to produce phosphoric acid by a wet process from rock sulphate in the first instance and then to treat it with the requisite amounts of ammonia. The recent T. V. A. developed process combines relatively pure electric furnace produced phosphoric acid and synthetic ammonia, and this product is even superior to the commonly produced mono-ammonium phosphate, which is prepared by a "Wet" process using phosphoric acid and containing only 11% nitrogen and 48% P_2O_5.

The renewed threat of war and the reduced supplies of sulphur from the U. S. A. on which most countries are dependent for the production of sulphuric acid, have turned the attention of these countries to find means of economising in the use of sulphuric acid in the production of phosphatic fertilizers. Nitric acid, because of its easy availability on account of its production from the plants that fix the unlimited supplies of atmospheric nitrogen, has shown to be a particularly promising substitute for the acidulation of rock phosphate. A recent British method using a mixture of 2 mols. of nitric acid to one of sulphuric acid has been found to give a fertilizer containing about 18% total P_2O_5 of which nearly 90% is water-soluble and in addition contains

about 4% nitrogen. The reaction in this method is found to be quite vigorous and reaches completion more rapidly than when sulphuric acid is used in the ordinary superphosphate manufacture, and yields a product with very satisfactory physical properties.

Semi-Acidulated Rock Phosphate

When rock phosphate is treated with half the quantity of sulphuric acid needed for superphosphate manufacture, a product is obtained which contains a large proportion of dicalcium phosphate and a smaller proportion of monocalcium phosphate ; the water-soluble form which predominates in superphosphate. The semi-acidulated phosphate, therefore, contains the major part of its phosphorus in the form of citric acid soluble P_2O_5 and a smaller proportion as water-soluble P_2O_5. The citric-soluble form has been found to be as available to plants as water-soluble P_2O_5 in superphosphates and that it undergoes less through fixation in soils rather slowly compared to the latter. Hence this product which is an innovation in the fertilizer field is likely to appeal much to our country where sulphuric acid is in short supply.

Potassium Nutrients

While the need for phosphate is universal, the requirements of potash fertilizers are restricted to certain crops and to soils which are deficient in this nutrient. Potassium is particularly needed by root and tuber crops like potatoes and also by tobacco. The normal supplies of potash salts have been from the considerable variety of the naturally occurring potash salts excavated from deposits occurring in Europe and America and recent work has been directed to preparing some concentrated forms of this nutrient for commercial supplies. One of these is potassium metaphosphate having a concentration of over 90% plant nutrients, being composed of 55% phosphate and 35% potash. This fertilizer is prepared by a wet process using potassium chloride obtained from the natural minerals and phosphoric acid. A new method developed by T. V. A. uses a comparatively poor mineral, Polyhallite ($CaSO_4$, $MgSO_4$, K_2SO_4, $2\,H_2O$), which forms the largest reserves of potash minerals in America, by treatment with phosphoric acid or phosphoric anhydride, P_2O_5.

Nitrogenous Fertilizers

Ammonium Nitrate.—During the war the nitrogen fixation industry had been developed to an enormous extent to produce nitric acid through ammonia and then from these two chemicals ammonium nitrate, an ingredient in the production of high explosives. As a result of such expansion, the production capacity of the United States for synthetic ammonia was estimated in 1944 to be in the vicinity of 1,200,000 tons

of nitrogen per year with individual plants like that of the T. V. A. having a capacity of 60,000 tons of ammonium nitrate and over, per year. Canada has three ammonium nitrate plants with a capacity of 1,20,000 tons of nitrogen a year. With the falling off of the military demands, ammonium nitrate has been diverted to fill the serious shortage of nitrogenous materials for agricultural purposes. One drawback about this fertilizer is its combustible and explosive nature and its hygroscopic property under humid conditions. This latter property causes the material to cake badly and make uniform distribution over land a difficult problem. Much progress has been made since 1943 to ensure against absorption of water, so that the products made available today largely do not suffer from these disadvantages. This is achieved by suitable treatment to granulate the crystals of ammonium nitrate and mix with 3-5% of tricalcium phosphate, kieselguhr, plaster of paris or kaolin. Further when ammonium nitrate is mixed with ammonium sulphate, superphosphate and similar materials used for making mixed fertilizers, the dangerous quality of detonation is largely lost.

Anhydrous Ammonia.—As a means of lowering the cost of nitrogenous fertilizer, anhydrous ammonia (liquid NH_3) and aqueous ammonia have been investigated for use on the soil. During the war period the potential supply of ammonia for use as nitrogenous manure was greatly increased, and it was found that the cost of the ammonia was just half that of nitrogen in solid nitrogenous materials like ammonium sulphate, nitrate, etc. Many American Experimental Stations have conducted research on applications of anhydrous ammonia and aqueous ammonia with safety and without loss, and to study crop response to such applications. With the effectiveness of ammonia established in terms of crop response, developments for a feasible and economic means of introducing same into the soil have been made. It is estimated that anhydrous ammonia has been used to fertilize and furnish nitrogen to over 1 lakh acres in America during 1947, through special machines fitted up to apply this fertilizer material. Ammonia as a fertilizer material is bound to be of great interest to our country because of the cheapness and the elimination of the acid materials like sulphuric, hydrochloric and nitric acids which are necessary to prepare solid material in the form of its salts. Sulphuric acid is prepared by burning sulphur and on this raw material our country is almost entirely dependent on imports from America, Sicily and Japan. And even in the method for preparation of ammonium salts through gypsum, we are dealing with an exhaustible commodity. Apart from reducing the production costs and reducing our dependence on imported raw materials, the use of ammonia is also likely to benefit the soil. Continued use of ammonium salts, *e.g.*, ammonium sulphate, is re-

cognized to cause acidity in the soil due to leaching and removal of the calcium of the soil in the form of calcium sulphate. The use of ammonia as such, is likely to diminish such harmful tendencies resulting from the use of ammonium salts.

There are thus a variety of new fertilizer materials which have been developed in the recent years and many of which have come into common use in the Western countries. The tremendous advances in technology made during the recent war have facilitated their production in large scale and supply to agriculturists at cheap cost. It is to be hoped that our country too would take early advantage of these developments to the ultimate benefit of Indian agriculture and our ryots.

ORANGE IN MYSORE AND MALNAD

K. M. Basavaraj, B.Sc., B.Sc. (Agri.)

Introduction

Oranges rightly deserve the place which, unfortunately, some other products have usurped. An orange is a balanced diet for both child and adult, irrespective of their age and size. As a valuable food it is administered even to the sick and the convalescent. Such an invaluable food is grown here, in our country, among others.

World at Large.—California, South America, Spain, France, Mediterranean regions, Russia, Iraq, Iran, China, Japan, Malta, South Africa, Australia and Ceylon may be mentioned as known for oranges.

India as a Whole.—India has plantations in Nagpur, Satara, Punjab, Madras, Coorg, Mysore and in a few other places.

Mysore in Particular.—Orange groves are practically confined to the hilly tracts in the Mysore State, known as Malnad. Particular taluks in which they are grown are : Chikmagalur, Kadur (Yemmedoddi), Aldur, Mudigere, Belur, Alur and Saklespur. Total area under citrus cultivation exceeds 3,000 acres.

A few hundred trees are raised round about Bangalore, but they are of little concern. These trees never grow taller than 15 to 20′ in height and bear economic yield only for about 5-6 years and dry up. These are raised by irrigation and with no shade.

Elevation and Slope.—The plant thrives at an elevation of 2,500′ to 4,500′ from sea level. If it is a slopy land, better if it be sloping to the east rather than to the west.

Temperautre.—The temperature in the tract in which the plant is grown ranges from 45 to 100° F., March to December ; but the normal temperature may be taken as 70° F.

Rainfall.—Annual rainfall varies from 80 to 100″ but we may notice flourishing plantations even when there is a rainfall of 60 to 80″ on the one hand, and 100 to 120″ a year on the other. But the success of the plantation in different zones depends on the fertility of the soil and other natural environments. It is needless to mention, therefore, that the plantations in Mysore are rainfed.

Soil.—In any land proper drainage is essential. Marshy places should be avoided. A soil that combines the good quality of black and red soils affords an ideal home for the plant.

Seeds.—Roughly about 500 good seeds can be had from 50 fruits which must be specially picked up from healthy trees of between 30 to 40 years of age. The suitable season to get seeds is September and October. Seeds from fruits which have dropped by themselves and

from ill-developed or immature ones should be discarded. The seeds are dried for a day or two in the sun and sown immediately, as the period of viability is very short.

First Nursery.—The selected locality for the nursery is dug well 4-5 times and the site is laid out into raised beds 0·6" height, 2½' broad and conveniently long. Manure is spread over the beds and the seeds are broadcast and covered with a layer of soil ½" in thickness. The nursery is kept moist till the seeds spread out by sprinkling water, covering the beds with plantain leaves and removing them in the evening till the seedlings come up is also in vogue.

Second Nursery.—By about 2 months, the seedlings will be about 2 to 2½" in height and now it is necessary to transplant them to a second raised bed nursery leaving about ½ to 1" space from plant to plant. This nursery is protected from the hot sun by a pendal through which light filters in. The nursery is kept moist and manured for a period of 2 years, after which the seedlings are transplanted to the field.

Third Nursery.—In the third nursery, the plants which are about 2 to 2½' in height are transplanted at a distance of 10 to 12" between one plant and the other. Before transplanting, the plants are carefully pulled out from the second nursery, and the top root and the plant are carefully pruned or trimmed to enable the plant roots to tiller well which is very essential if we wish to have beautiful dome-shaped trees out of these young ones. Transplanting is done in June or from the beginning to the middle of August. The plants are left in the nursery until they are finally removed to the estate. The nursery is managed well with regulated manure and water supply and the weeds removed constantly. The plants are left in the nursery for 2 to 3 years by which time they will be of about 5 to 6' in height.

Vegetative Propagation.—In addition to getting the plants from seeds another very common practice highly prevalent among orange-growers is to get ready made plants about 4 to 5' in height in about 8 to 9 months, and this is by marcoting or gootying. It is an art by itself and demands skilled labour for the work. A suitable healthy branch of about ½ to ¾" thick, arising on the tree at about 3 to 4' in height is selected for the purpose. The bark of the branch for a length of about 2½ to 3" is peelel off very carefully by a sharp knife at a distance of about 3 to 4" from the origin of that branch. Fine loamy soil in powdery condition is mixed with farmyard manure in the proportion of 1 : 1 and this is made use of to cover the peeled off portion to a thickness of about 1 to 1½" all round. Plantain strips or old gunny bag pieces are made use of to bind this soil from dropping. The whole of this process is known as marcoting and this is done in January and February. By about August we can notice roots pro-

truding out though the torn plantain strips which show that they are ready for transplanting. These branches are carefully cut off from the trees at their origins and they are for all practical purposes like nursery plants 4 to 5 years of age raised by seeds. In Kannada marcoting is known as *kasi kattuvudu*. Ringing and budding methods are unknown to the planters. It is said that trees raised by marcoting will have a shorter life. There seems to be some truth about it. One advantage of marcoting is that it will save the time and labour required to raise the nursery ; and also the trees will mature early.

Plantation in the Dry Land of Malnad.—Dry lands are generally being used to grow oranges in the Malnad. This is for various reasons, such as, the availability of dry lands, the cheapness with which they can be secured, scarcity of labour, and, besides all, the wrong conception that orange plants come up better in the dry lands than in the estate jungle land. But experience gained at a great cost has shown that dry lands are not suited for orange plantations. Attempts to raise plantations in the dry lands have only revealed that the plants do come up well for about 10 to 15 years after which the trees will gradually begin to lose their vigour and finally dwindle away.

Suitable Location.—Orange gardens demand fertile and well drained soil very similar to that of a coffee estate. Any coffee estate may be converted to an orange garden, if one so likes it. Their requirements and locality are identical.

Shade.—Different people are putting forth different arguments to justify their conception as to whether an orange garden requires shelter or not. This is a practical problem depending on sound judgment. It can be stated that orange plantations in Mysore (Malnad) do require shade and that without shade orange gardening is a failure. By keeping shade, a cool atmosphere is maintained in the garden, the rate of evaporation from orange plants is lowered, oraganic matter is added to the soil, evaporation of soil moisture is lessened, and most important of all, the trees are not open to sun burn. Besides the tree belt round the garden and shade trees prevent the sweeping in of pests and other micro-organisms like fungi and bacteria and also protects the fruit-laden tree from the terrific winds and torrents of rain. The shade trees should not bar the sunlight altogether, but should be so regulated as to let filtered light to pass through by practical experience, people are aware that the trees under shade will have long life and are less subjected to diseases. Silver oak, *Erithrina indica*, Bilwar, *Dalbergia glizirhiza*, Kabbasari and other species of trees may be preferred for shade trees. It is sufficient, if shade trees are at a distance of 40 to 50′ between one another. It cannot be desired that there are some disadvantages in keeping the shelter, but considering the various

aspects of growth of a tree, its life, and its economic bearing capacities, and besides the peculiar adaptability of an orange tree in Malnad, the balance of argument is for keeping orange gardens under shelter.

How to Provide Shade.—The next thing to be considered is how and when to keep the shelter. Practical experience has revealed that orange plants come up well in non-shady areas than in the shady ones, but this continues only till the plants begin to bear fruits. When once the trees mature, the above phenomenon is reversed, and as the years roll on, the vigour of the trees goes on deteriorating until they dwindle away. This shows that young plants need no shelter, but the matured ones do need it. This question may be solved by planting shade plants along with the transplantation of the orange plants to a newly cleared jungle. In this case the shelter plants so planted will grow taller than the orange trees by the time the latter mature, and thus form a good shelter for the garden.

Measurements of Pits.—The size of the pits to plant the orange plants differ depending upon the conception of the individual planter. But better if the breadth of the pit is 3′ and the depth is 2′ and the shape of the pit is circular. The pit is filled with 3 to 4 baskets of farm-yard manure mixed with tank silt, if available. The plants are carefully removed from the second or third nursery with a ball of earth of about 10 to 12″ on each side around each plant. Each such plant is taken separately in a basket to the garden which has already been laid out into pits and a single plant is planted to a pit. Care should be taken to see that the plant is not planted either below or above the ground level to which the plant was standing in the last nursery. It is to be remembered that there is no harm if the plant is planted a little above, but never should it be planted below in which case it will have a harmful effect on the successful growth of the plant.

Spacing.—Regarding spacing different people hold different opinions, some say the trees should be 18′ apart and others say they should be 22′ apart. A well-grown tree sends its branches to a radius of 12 to 15′ and therefore we may safely infer that the roots of the particular tree will travel as far as 12 to 15′ round about a tree. This in turn helps us to know that each tree needs a space of 25 to 30′ for its successful growth, otherwise if planted close to each other there will be no sufficient root-room and thereby unhealthy competition for food and water begins. Any way spacing should be judged according to the fertility of the soil. If planted at a distance of 25′ apart 75 plants can be planted to an acre ; and if planted at a distance of 30′ apart, 50 plants can be planted.

Cultural Operations.—Inter-cultivation commences after completing the transplantation. A good gardener gives an all out digging once

a year. Constant stirring of the soil round about a distance of 2 yards of each tree is done as a matter of routine during the first 4 to 5 years and 4 to 5 baskets of manure applied every year. This till the plants are about 9 to 10 years old. Now onwards till the plants grow to an age of 14 to 15 years, the soil beyond the radius of 1 to 2 yards from the trunks and upi to an extent of 3 to 3½ yards radius from the plant is stirred constantly and 6 to 7 baskets of manure applied year after year. After 14 to 15 years the plants begin to bear economic crops and need more of food and shade for their successful growth and progressive yield. So, the dose of manure is doubled and about 15 to 20 baskets of manure spread round a tree and the whole garden kept stirred as a matter of routine. It is to be noted that land of a radius of 1 yard round a tree is never stirred and it is no use handling it also.

Manuring.—Even when manuring it is good to draw the surface soil to a side over a width of 1½ to 2 yards beyond the radius of about 2 yards from the tree and then spread the manure evenly. The drawn up soil is afterwards covered over the area from which it was drawn out. October and November is a good season for manuring.

In case of scarcity of farmyard manure, castor or groundnut cake may be applied twice a year at the rate of 400 to 500 lb. per application, to the acre. Artificial manures may also be added in the following proportions for better growth :

Ground oilcake	..	300 lb.	The total quantity of 500 lb. applied per application twice a year.
Superphosphate	..	200 lb.	
Potassium Sulphate	..	100 lb.	

Trenches of the measurement 4′ long, 1′ broad and 1½′ deep are to be dug at right angles to the slope of the land to check the erosion of the surface soil. These may be dug at a distance of about 20′ apart. This helps the soil to weather well and the roots to tiller well. Making use of this opportunity, manure may be added to the trenches during the next year before filling them up while giving an all out digging. Fresh trenches may be scouped out at alternate positions to the previous trenches.

Pruning.—The weak and old branches and the sucklers are removed every year in October and November. If there is a branch suspected to be dried out of some disease, it should be removed and burnt. Whatever may be the age of the tree, the stem will never grow over 1′ in diameter, and a height of about 40 to 50′. The variety of orange grown in Mysore is known as 'Coorg Orange'; both skin tight and jacket oranges are grown in the State, but the former is common. The fruits are slightly sour to taste unlike Nagpur oranges, which are very thin-skinned and very sweet.

Seasons and Blossoms.—A well-managed garden begins to bear in 7-9 years after planting. The trees put on flowers twice in a year and this is seasonal. The first crop in the year is in January and February and this is called summer crop ; and the second crop is in July and August and this is known as rainy season crop. It is common to notice that the summer crop is more economic considering the quantity of yield, the quality of fruits and the high price it fetches.

Harvesting.—The fruits are picked carefully, put in baskets, and packed for the market. It should be noted that the fruits should not be allowed to ripen fully on the trees. If they are to ripen to the maximum extent on the trees and then picked, no doubt the fruits fetch more money, but it is detrimental to the trees themselves ; their life lessens ; and there will be low yield for the years to come. To avoid this danger, the fruits may be carefully picked when they are three-fourths ripe.

Yield.—The yield is according to the fertility and the management of the garden. It may vary from 15,000 to 30,000 fruits per acre in a season. Generally the older trees bear larger crops. The price for 1,000 oranges varied from Rs. 20-0-0 to Rs. 80-0-0 depending upon the quality of fruits and the season.

Life of the Garden.—The life of the orange plantation depends upon the factors already referred to ; and it may be taken to be about 40 to 50 years.

Insect Pests.—Leaf-eating caterpillars are commonly found in large numbers in an orange nursery. A rare visitor in a garden is the fruit-moth and the borer is a considerable pest of the plant.

Diseases.—Fungus diseases appearing are gummosis, scab, sooty moulds, the yellow disease and the dieback.

In 1946-47 there appeared a mysterious disease soon after the monsoon rain was over, which resulted in the shedding of the leaves, leaving the trees bare like deciduous ones. There are varieties of orange trees which shed their leaves once every year and again put on fresh foliage with renewed vigour ; but the defoliation of 1946-47 was different as the Mysore variety of oranges do not come under that category. When this happened all the planters were desperate ; but luckily, 80 to 90% of the trees, however, recovered.

Unfortunately again in 1947-48 the old history repeated in a different way. As soon as the monsoon rains were over, there appeared a white ashy powder-like substance covering the upper and lower surfaces of the leaves on the orange trees. This is noticed in many parts of Malnad, such as Belur, Sakalespur, etc. This is now known to be 'Mildew'. The Mildew is a fungus disease which, if it persists, will root out the whole of the orange gardens. The remedy for this is to

spray with Bordeaux mixture ½% (2-2-40) or 1% solution (4-4-40). The treatment has its effect, only if the attack is in its initial stages. In case sulphur is available, sulphur dusting may also be done to control the disease. Better if the trees are sprayed once a year before the monsoon rains to be on the preventive side.

Thus recently orange growers have experienced hard times. This is naturally driving them to think that the orange industry is not a dependable one, and this should be taken up only as a side business or a side crop, having some other crop as the main one on which to rely. There is truth in their opinion, because if a person who, after spending a great amount of money for nearly 15 years without any income, were to lose his garden by some disease which he does not know how to prevent or cure, he is forced by circumstances to carry on propaganda against orange cultivation.

Success of Orange Trees as an Inter-Crop.—Having this background in view many people have taken up planting orange as an inter-crop in coffee estates. No striking harm for either of the crops has been experienced. Besides, the income is doubled for a given expense.

Present Position.—Growing of oranges has begun to appear like gambling. Considerable researches seem necessary to save the crop from frequent dangers and make it secure for the planters to take up. This calls for Government Experimental Farms, which may be opened near Belur or Sakalespur, where the oranges are grown in abundance.

Gardener's Responsibility.—It is also left to the gardeners to have their own organisation to obtain reasonable prices for the produce and to make use of the service of the Agricultural Department when and where possible. Gardeners should realize, to start with, that they are not only benefiting themselves by raising orange gardens but are also doing some service to one and all by supplying an important raw food for a better standard of national health. If circumstances so arise and the output of the produce is large, canning factories may be opened which will undertake the responsibility of exporting orange juice and raw orange in bottles ; and thus, opening of a factory of the type is a great asset to the industry, as it would secure an equally good price for the rainy season crop which has now to be sold at considerably low rates.

Task Ahead.—The Experimental Farm in turn should have to bear the responsibility of supplying good seeds and seedlings, to make available sufficient knowledge about vegetative propagation and its benefits, to acquaint the growers about the use and dosage of different manures, the way to improve the quality and yield of fruits, the art

of pruning a plant, the preventive measures to check the attack of diseases and the immediate curative measure to control the diseases in case the preventive measure fails and last, but not the least, the general management of garden.

Unless something like the above is done it is to be feared that no substantial help can be rendered to better the lot of the disappointed orange growers.

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(Sri. R. S. Subba Rao, L.Ag., of Belur, who is on the Managing Committee of the Union, has kindly gone through the manuscript and the following is by him.)

Task Ahead.—The orange gardens are a national asset. We desire the Government should come to the aid of the gardeners, as they have done in the case of coffee. A Research Garden should be opened and maintained by the Government in a central place in the orange-growing area of Malnad.

Like cotton societies and cardomom society a fruit society should be opened. There was one such society at Belur, but it died in its infancy. Even now the Government should take initiative by taking the gardeners into confidence and start such societies and thus help the industry which is of a great value to the nation as a whole.

AGRICULTURAL EDUCATION IN U.S.A.

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Introduction

The need for a more expanded programme in agricultural education in India has never been more urgent and pressing as at present time. Agriculture, the most important of our industries, should be given more attention, and immediately too. We have not only to step up our production but also increase the efficiency of the methods we employ. It is even more important to see that in our enthusiasm to produce more we do not exploit and destroy the land, the richest of our heritage. Our own experiences in the Orient as well as recent instances in some of the Western countries are an evidence of the fact we have not yet learnt to utilize our resources more efficiently. If these sad stories are not to be repeated again the public, more particularly the farming community, has to be educated not only in the art but science of farming as well. The nature of education should be such that the common man develops a keen interest in land not by inherited devotion alone but also by a real understanding of the most efficient methods of management.

We are fortunate to some extent in having our access to some of the results of experiments and undertakings in the field of agricultural education in Western countries. It is true, however, that the cultural backgrounds are not the same in different countries, particularly between the Orient and the Western world ; and what may be best suited

in the United States for instance may not be as effective in India. But we can always profit by their experience, particularly as regards principles and some of the methods. With this idea in mind the following picture of the agricultural education system in the United States of America is presented.

Although developments in the United States are comparatively recent it is interesting to note that the far-sighted citizens realized the importance of, and urgent necessity for some sort of programme to educate the farming community as far back as 1785. That year saw the birth of the first agricultural society in America. It was the Philadelphia Society for the Improvement of Agriculture. Beginning in this period agricultural societies developed and flourished for almost a century. One of the main objectives of these societies was collection of agricultural information and making it available to the farmers. The year 1862 saw the enactment of the Morill Act which made possible the institution of the now famous land grant colleges throughout the nation. Through all these years since 1862 these land grant colleges have come to be the fountainheads of higher learning in agriculture and mechanic arts.

About the beginning of this century another significant development in the field of agricultural education took place. This was the starting of Vocational Agricultural Education Instruction in High Schools. At the present time many of the high schools throughout the nation have not only expanded their programme of instruction but are dealing with varied programmes such as adult training, veterans' training, etc. Apart from these two major institutions quite a number of private organisations take active part in spreading agricultural knowledge to the public in general and farmers and others who are keenly interested in farming in particular.

Land Grant Colleges

As mentioned before, the land grant colleges were established by the Morill Law of 1862. The colleges were so named because the law provided a grant of land to each State on the basis of 30,000 acres for each member of the United States Congress. The land thus granted was to be sold and the proceeds invested in State Certificates of indebtedness at 5% interest. The income from this was to be used for the "endowment, support, and maintenance (in each State) of at least one college where the leading object shall be, without excluding other scientific and classical studies and including military tactics, to teach such branches of learning as are related to agriculture and mechanic arts in such manner as the legislatures of the States may prescribe in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life". As a result

there came to be established at least one land grant college in every State of the Union. In some States it is a part of the University ; in others it is independent, in either case controlled by the State Board of Education. Through the years these colleges have attained a high degree of fame for their almost unparalleled work in the field of teaching, research and extension, the three closely knit functions of the land grant college. The significant feature of these colleges and the public sentiment towards them is well expressed by the following quotation : "It is unique among educational institutions of the United States in its insistence upon democracy in education ; its close co-operation with a basic industry ; the completeness of its educational programme ; its reliance upon scientific research ; the training of its students to prepare them for specific and practical service ; its comprehensive programme of adult education of a kind which is directly usable by the farmer and his family ; its direct relation to Government ; its great contribution to the conservation of our natural resources ; its recognized leadership in the progress, development, and permanent improvement of the rural population ; and indirectly but no less certainly, its contribution to the broader purpose of the public welfare."

Teaching

One of the main objectives in founding of these land grant colleges was to offer courses covering subject-matter which is of practical value to the farmers. Some colleges started their objective as to make master farmers thoroughly based in the sciences relating to agriculture. The University of Wisconsin in its early stages stated, "It is the design of the University to give in this Department (Agriculture) a thorough course of instruction directly pertaining to agriculture, which will enable our graduates to conduct the operation of a farm both intelligently and profitably." The present-day teaching in these land grant colleges is designed more or less on the same pattern to impart to the students not only a theoretical background but more of a practical training in the field of agriculture.

Research

One of the greatest handicaps, the land grant colleges experienced in their early stage was the lack of an organised body of agricultural knowledge. Teachers had to contend themselves teaching pure science in the newly started agricultural colleges. People, and more particularly farmers, became skeptical about the usefulness of these colleges founded specially to help the farmers. The leaders began to feel the need for extensive research and scientific investigations before these colleges could accomplish the purpose for which they were founded. The outcome of this was the Hatch Act of 1887 establishing agricultural experimental stations throughout the United States attached to the

land grant colleges. Even before this agricultural research was being conducted here and there, and there were even a few agricultural experimental stations in some States. But the passage of this legislation meant the recognition of the responsibility of the Federal Government for the progress and development of the agricultural industry through research. Since then Adams Act of 1906, Purnell Act of 1925, Bankhead-Jones Act of 1935, and recently the Research and Marketing Act of 1946 have contributed financial support and stimulus to agricultural research in the States. In addition the two last-mentioned Acts require off-sets by the States, and this has added further appropriations from the State Legislatures. Another special feature is the number of Co-operative Research Projects, and the high degree of co-ordination between Federal and State research workers. Particularly the latter is one of the major factors responsible for such a high standard of research in this country as well as the high degree of success attained by these experimental stations. In addition to the research programmes within the States, the United States of America carries on research work on general and regional problems in the Central Research Station at Bellsville, and the 9 Bankhead-Jones Laboratories and 4 Regional Laboratories scattered all over the country. Agricultural research conducted primarily in Laboratories, Greenhouses and Experimental Farms has been making available to teaching more and more valuable and new information in the field of agricultural science. This constant flow of information from research to teaching is making agricultural education in colleges and schools and even outside, more and more practical and useful to farmers. In consequence we now see everywhere a clamour on the part of students to enter into the agricultural colleges. Many of these students are those with an ambition to take up farming after their school or college education. Farming profession is getting more and more of the educated class of people, educated well in the science and practice of agriculture. Perhaps this is one of the weightiest factors contributing not only to the success but a high standard of agriculture in this country.

Another noteworthy feature is the support, both moral and financial, given by the industries to these experimental stations. Almost all the experimental stations in this country are receiving research grants from a large number of industrial concerns for conducting research in some specific projects in which the respective industries may be interested, and also Fellowship for Graduate students who are working for advanced Degrees. The magnitude of research conducted by private industrial concerns like Hybrid Corn Companies, and Dupont Chemical Industries and Texas Research Foundation, Rockfeller Foundation and Carnegie Endowment in this country may be noted.

The educational value of these experimental stations to the actual farmers is realised in the field days frequently held on almost every experimental farm ; open houses in colleges throwing open the research laboratories and green-houses and special farm and home weeks when farmers are given a first-hand knowledge of what is going on in the field of agricultural research. Apart from bringing the farmer up to date these occasions are very important in gaining the public confidence in an agricultural research programme which is so very essential for the progress of any governmental agency.

Extension

Agricultural research would be futile if the information is not made available to the farmer. This, as well as the need for constantly getting the farmers' problems to the research workers, were responsible for the establishment of the agricultural extension service. Although existing even earlier in many of the States, the co-operative extension service was formally brought into effect in 1914 by the passage of the Smith Lever Act. A special feature of this (that is where the word 'Co-operative' comes from) is the co-operative working relationships between federal and State extension services on the one hand and between the extension service and private organisations interested in farming industry on the other hand.

Agricultural extension service in the United States is perhaps one of the best organised and most effective in transmitting research information to the farmers. It is important to note the headquarters of the extension service in the States is in most cases in the land grant colleges. County extension services (actually working with the farmer) are directed by the State Extension Director who is assisted by a well qualified staff of supervisors, subject-matter specialists, etc.

Holy Trinity

It would be best to regard the three imporant phases of land grant colleges, research, teaching and extension as a holy trinity working together with a high degree of harmony and co-ordination for the common good of the farmer. The tendency in recent years is to bring all these three phases under one head so as to bring more effective co-ordination. Already many colleges have gone farther ahead in this direction. Perhaps this effective and organised co-ordination between research, training and extension should be regarded as a major factor in increasing the efficiency of the agricultural services to the farmer which, after all, is the primary objective of these institutions.

Educational Facilities at the Land Grant Colleges

The land grant colleges are the seat of learning the art and science of agriculture. These are the only institutions fully equipped first to

establish the facts, second to develop the techniques for actual owners and cultivators of the soil. The training in these colleges has been to prepare students for a great variety of successful enterprises in which a knowledge of agriculture is important.

The nature of the courses offered in these colleges varies in different States although in regard to the fundamental courses there is more or less uniformity. Even there the organisation of the courses depend pretty much on the type of local agriculture and the instructor. Advanced courses in different branches are offered depending upon the availability of the instructor (who is invariably the research worker and a specialist in his field). Facilities for research work are available in almost all these land grant colleges leading to advanced Degrees. However, the selection of an institution for research by a student depends upon the particular branch he is interested in, and the availability of Research Professors in that field. For example, if one is interested in irrigation agriculture, he will have to select one of the Western States like Utah or California ; if interested in draining one of the Eastern States like the New England States or the Wisconsin or even some of the mid-Western States ; if interested in cotton, one of the southern States like Texas or Mississippi or North Carolina ; and so on. In all these colleges there are very good facilities available for research ; and more important, very good encouragement is given. Quite a few teaching assisted Studentships and Research Fellowships, some supported by the research grants from the various industrial concerns are available to research students. Enthusiastic research students find both the facilities and encouragement. With all these progressive spirits, it is no wonder agricultural research of a high calibre is being conducted in many of these land grant colleges.

Degree Courses

Regular courses leading to the Degree of Bachelor of Science (B.S.) in Agriculture takes normally four years after Matriculation. Although Degrees in General Agriculture are given in some colleges, in others it is however, more specialised. Accordingly students may select one of the many branches such as Agronomy, Animal Husbandry, Dairy Industry, Agricultural Engineering, Agricultural Economics, Agricultural Education, Forestry, Horticulture, Irrigation Science, etc. Even here one has to take certain required fundamental courses in many of these subjects. However, under the category of electives a student can select certain courses he is interested in up to a prescribed limit. A special feature of these courses is the emphasis given to practical aspects of the subject; during summer vacation many students work on farms and earn both money and experience. Some students, however, stay and take courses in the college during the summer session.

Certificate Courses

These courses leading to a Certificate are designed for those who wish to get back and farm, and for that reason want to get courses in practical agriculture. These courses are designed primarily with the intention to stressing the practical aspect of farming more and more. More or less similar courses are offered in other subjects like dairy plant operation, animal husbandry, forestry, floriculture, food management, fruit-growing, ornamental horticulture, etc., and vary in different States.

Short Courses

Short courses are organised courses in lectures and discussions extending in duration from a couple of days upto two years, and are an important means of adult education. These are designed to meet the needs of the people interested in differenct aspects of agriculture, such as farm operators, fertiliser manufacturers, artificial breeding associations, bee-keepers, cattle feeders, pest control, etc. These short courses are being given more attention nowadays because their need is being felt keenly. In response some colleges offer a good number of these short courses. For instance, New York State College offers 84 short courses, Iowa State 46, Colarado State College 55, and so on. Ordinarily no fee is charged. But some courses do require a nominal small fee. These short courses help to keep the various sections of the farming industry abreast of the latest information in their respective branches.. This is one of the key notes for keeping the progress going.

In-Service Training and Special Courses

It is of utmost importance to keep the junior staff and field staff informed of the latest developments and advances in the several branches of agriculture. This is made possible by special workshops, refresher courses, District and State Conferences, etc. Regional workshops are of particular importance. At a workshop lectures are given, then the participants organise into work-groups according to their interest and work upon some particular aspect of the general problem. At the end the findings of the different groups are brought together and discussed. Refresher courses in special subjects are held almost every year at the college, and the extension workers get a good idea of the subject-matter. District and State Conferences, special discussion groups, National Conventions, etc., all add to the knowledge of the extension field personnel and bring them up to date.

Agricultural Extension Teaching

Agricultural Extension Service in the United States of America, because of its fine democratic principles and its accomplishments through

the years, has been one of the most popular and effective of the services in educating the rural community in the art and science of agriculture. Its motto is to work with the farm people and not for them ; to help them help themselves. The extension teaching is oriented in such a way that the farmers recognise their problems, find solutions through thinking and co-operative efforts, and apply the solutions to their own problems. Through this process it is designed not only to improve the farmer's living standard but through that make him participate in social affairs and contribute to the progress of a rich culture.

One of the most effective and major extension approaches to educate the farmers is through nearly 2,000,000 recognised voluntary local leaders. Leadership training therefore is one of the most important functions of the Extension Service. For it is on their good training that the transmission of agricultural knowledge from the colleges to the farm people depend. A great number of leadership training meetings are held almost in every county. Local extension service personnel and subject-matter specialists from the colleges go over to these meetings and help to give a good practical training to the local leaders in the particular subject-matter. The training period covers from a couple of days to one week during which time the leaders learn by actual doing. This is more important because they have to demonstrate the same methods to the farmers when they get back to their respective places. Special summer camps, conferences, discussion centres,, serve the same purpose. In addition, special short courses are conducted at the colleges to train these leaders. The 4-H activity by both the 4-H boys' clubs and 4-H girls' clubs is too well known, in the United States and has won the full support and recognition of the parents, legislators and foreign visitors. More than 50 different methods are used in extension to carry the information from the college to the farmer and to see the farmer applies it on his farm.

Special mention should be made of the county agents who lead the extension service at the grassroots level in the counties. On their ability, energy, sympathy and understanding depends the successful teaching of the art and science of agriculture to the farmers. County agents command a high respect in rural communities. and they play an important part in shaping the American way of life.

Vocational Agriculture

Instruction in vocational agriculture is offered in nearly 9,000 secondary schools in the United States. The agricultural instructors are Graduates from the agricultural colleges—many of them with a Degree in agricultural education. These instructors maintain close contact with the county agents. Emphasis is given in the curriculum

to practical work by the student. The principle is to learn by actual doing.

The general objectives of the instruction vocational agriculture are :

(1) To assist each pupil to select the farming or agricultural occupation which he wishes to follow.

(2) To give each pupil the training needed for this occupation.

(3) To assist him in getting established in the occupation of his choice.

Corresponding with vocational agriculture in boys' education, girls take vocational home economics and they are amalgamated into an organisation known as future home-makers of America.

A special feature of this is the supervised farming projects which each student will have on his farm or in his home. These projects may be rearing a calf or construction of farm gates, or handling and maintenance of a tractor, etc.. The agricultural instructor supervises over these students' projects ; many high schools have their own farms, as in California, which the students operate.

Students in vocational agriculture are often enrolled as future farmers of America, an organisation having local chapters, State associations and National organisation. They too work on special projects. More important, they are trained as good leaders in agriculture and thus they are of immense service to their own communities.

A special feature in this is that during their training in vocational agriculture, most of the students become keenly interested in agriculture as a profession ; and either pursue agriculture in college or return to farming. Thus farming industry is gradually getting more and more educated and qualified people.

Instructions in vocational agricultural education are also having a programme of adult education. Night schools for farmers are held at convenient places and at convenient intervals and special problems are discussed. The instructor often times goes over to the farms of the night school members and offers practical suggestions. This may also be carried out on project basis.

Another programme attached to the Vocational Education Department in high schools is the veterans on the farm training. War veterans settling on the farm are given advise and help frequently by a member of the Vocational Agricultural Education Department.. This began in the early years after the Second World War when the veterans got interested in farming and began settling on new farms.

Vocational agricultural education in high schools is of great help in one way. Many of the students would like to go for farming or some other business after their high school education. In such cases a knowledge of practical agriculture would be of much help to the students

who will not have any opportunity to get college education in agriculture. Also a knowledge of agriculture would be very valuable to those students who, after their high school education, settle in business or industries in agricultural communities.

Other Agencies

Outside this Governmental agencies the role played by the private organisations and industrial concerns in educating the farm community in particular and public in general is marvellous. To mention only a few, Farm Foundation, National Fertiliser Association, American Plant Food Counsel, National Cotton Counsel, Belta Counsel, Farm Bureau, Farmers' Union, Grange, Farm and Home Sections of some of the leading dailies, some of the leading radio stations. In addition to these there are a multitude of others interested in furthering the cause of agriculture and educating the public.

The Farm Bureau is a leading farm organisation closely co-operating and working with the extension service. The organisation is active at the county, State and national levels, in arranging for educational meetings, conferences, discussion groups in addition to its interest in legislations relating to agriculture. Farm foundation is a non-profit association created by a Trust Agreement in 1933. It is interested in improving the economic and social well-being of people on the land. It sponsors graduate scholarships, extension workshop, training of rural pastors, arranges public policies, forums and a number of other projects. In September 1949, the Radio Station WOI and the Farm and Home section of the Detrois Register and Tribune Paper jointly sponsored the National Soil Conservation Field Day and ploughing contest. It saw a gathering of over 80,000 people most of whom were farmers. The occasion has a very high educational value in capturing and stimulating the interest of the farmers in many of the improved agricultural practices. The National Cotton Counsel sponsors annual conferences such as Cotton Mechanisation Conference, etc., where people of different interests in cotton assemble and discuss. So also vast numbers of other organisations have active programmes to educate the public in agriculture.

These organisations arrange frequent symposiums, conferences, special lectures, workshops and discussions on major current farm problems. The information is spread to the farmers through publications, regular farm journals, reports, and daily papers. Most of the leading daily papers devote a section for farm news, and on Sundays publish a farm edition. Almost all the broadcasting stations carry programme in agriculture every day at least for some time. The television is becoming an important and effective means of teaching the farmer

on the farm. In brief, the farmer in this country is offered assistance and a free and easy access to new information at all times ; and with all this it is indeed a privilege and a pride to be farming.

Conclusion

The brief picture of agricultural education in the United States just presented brings out many important features. Of paramount importance among them may be mentioned the facilities offered for all sections of the community. Of equal importance is the part played by the private organisations in promoting research on important farm problems, and in educating the public in farming affairs. Both these public and private agencies are striving hard to keep the farmers in particular and the public in general informed of the latest information on the various aspects and problems of farming. The result is the widespread recognition of the importance of agriculture in a permanent national economy. Truly these land grant institutions, agricultural extension service, and other public and private agencies mentioned above are to be highly credited for bringing a public awakening to agricultural problems, the bright consequences of which we are witnessing now in the Western world.

PROTECTING PLANTS FROM PESTS AND DISEASES

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The need for protection of crops from the ravages of pests and diseases cannot be overemphasized. Attempts in that direction by our farmers is not very satisfactory due to various reasons, economical and otherwise.

Many pests and diseases are periodical and hence their incidence is noticed in certain months ; if duly attended the havoc could easily be averted. Treatments like "seed dressing" or isolation of the earliest affected crop would save much of the subsequent disaster. Seed treatment involves mere immersion of seeds to be sown in certain solutions, common among others being copper sulphate for a specific period. Pulling out the earliest affected crop is not only practicable in the early stage but also the best method to check the spread of the disease or pest, the loss being negligible loss of the portion of the crop. The point is to put some of these points into practice.

Losses due to pests and diseases are really shocking. For example, 200 maunds of potatoes are lost per acre due to Alternaria where the yield should have been 400 maunds. The destruction in many cases ranges from heavy to complete loss. Many do not seem to be aware that crops could be actually saved from such a disaster. The loss of 200 maunds of potatoes which costs Rs. 1,000 approximately could have been easily saved probably spending at the most about Rs. 50. The ryots could always command the technical advice from the Department.

A crop is susceptible to be attacked either by disease or pest at all stages, from the seed to the fruit. The standing crop is often attacked ; and very often the trouble may appear at the harvesting stage when all the energy and labour will many a time be fruitless. Nor is the produce quite safe when the harvest is done, as even in storage the attacks of pests and diseases continue.

The nature of infestation and treatment to be adopted differs according to the stage in which the crop or produce is attacked. It may be mentioned in this connection that there is always a point in the life-cycle of pest or disease which is the weakest link in the whole chain. Thus, when a seed-borne disease has to survive, it will make its way and remain along with the seed and when the

seed germinates into a seedling the disease takes the opportunity of affecting the seedling which is young and susceptible and destroys the crop. The presence of the disease along with the seed is the weakest link in the life-cycle of that disease and when one is able to separate by proper scientific method the seed and the disease and make the seed pure and free from disease, one is sure to save the crop. Many of the diseases are found along with the seeds and hence are "seed-borne diseases" and proper scientific method of separating the seed and the disease is called "seed treatment". Many diseases though they show out on the standing crop, really originate from the affected seed. Thus seed treatment may be taken up whether the seeds are suspected of the disease or not; most of the diseases are so eliminated. The most common "Benki-roga" on paddy is a seed-borne disease and it can be effectively prevented by seed treatment.

The disease or pest on a standing crop varies from slight to very heavy infestation. Loss may be enormous. It is to be taken into account that treatment on a standing crop is very laborious and involves equipment and technical personnel to overcome and combat disease or pest.

Then comes the attack at the harvest stage. Here the risk involved is the greatest and all the human labour and energy will be fruitless even if there is a slight delay. There is a close correlation between the period of fruiting and the intensity of the pest or disease. At the harvesting stage the intensity of the pest is severe and is parallel to this short period. The destruction is to be completed within the available time. Hence in most cases proper protection has to be provided just before the harvesting or fruiting period sets in.

Last but not least is proper storage. With all the efforts taken to preserve the fruit on the crop, it becomes useless if storage is neglected. It is here that there is many an opportunity for the spores of the disease to mix with healthy grains later to be a menace by way of seed-borne diseases. One should be careful therefore not to mix the affected crop to come into contact with that portion of the harvest which is especially intended for seed-material.

Equipments like dusters and sprayers, though costly (hand-operated ones varying from Rs. 50 to Rs. 200) will be worthwhile possessing as the costs are negligible when compared to losses incurred when the whole crop is lost. Large-scale dusting and spraying require power equipment, which, as at present, have to be provided by the Government.

But Government itself cannot provide equipment to every one. Ryots should also come forward with a definite co-operative plan. This is essentially a great step forward in the growing of more food for a grain saved is a grain grown.

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